Constant Current Switching Regulator for White LED

Halogen Free

General Description

The FP7203 is a Boost DC-DC converter specifically designed to drive white LEDs with constant current. It provides built-in 140mΩ/4.5A/18V N-MOSFET. The non-inverting input of error amplifier connects to a 0.25V precision reference voltage and internal soft-start function can reduce the inrush current. Over voltage protection set by external resistor. DC voltage and PWM signal dimming can be adjusted by an external circuit connecting to the FB pin.

The FP7203 is available in the SOP-8L(EP) package and provides space-saving PCB for the application fields.

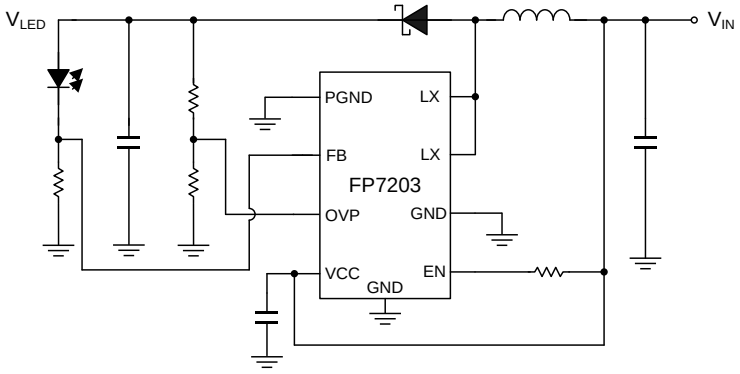
Features

- Start-up Voltage: 2.6V
- Adjustable Output up to 14V
- Precision Feedback Reference Voltage: 0.25V
- Shutdown Current: 0.1μA
- Internal Fixed PWM frequency: 500KHz
- Internal 140mΩ, 4.5A, 18V N-MOSFET
- Over Current Protection
- Over Voltage Protection
- Over Temperature Protection
- Package: SOP-8L(EP)

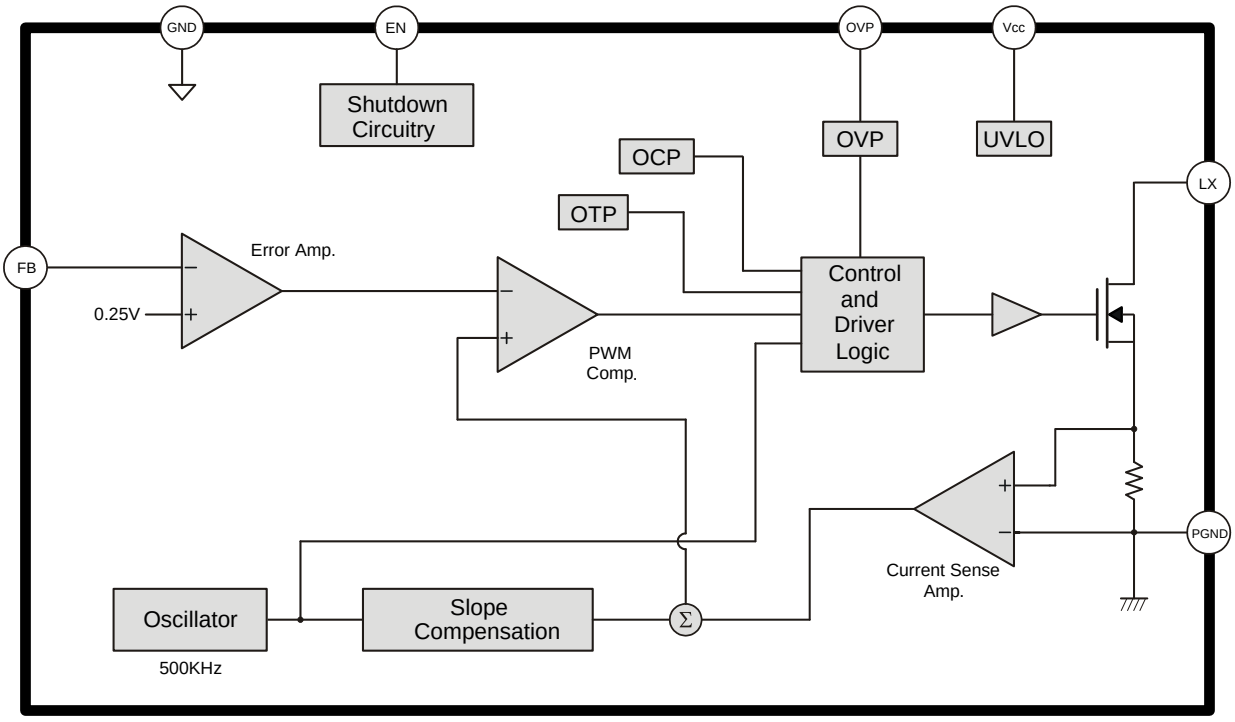
Applications

- LED Module
- Display Backlight
- Flashlight
- Portable LED Lighting

Typical Application Circuit

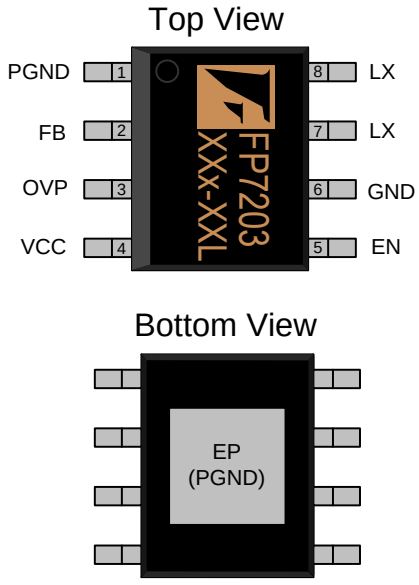


Function Block Diagram



Pin Descriptions

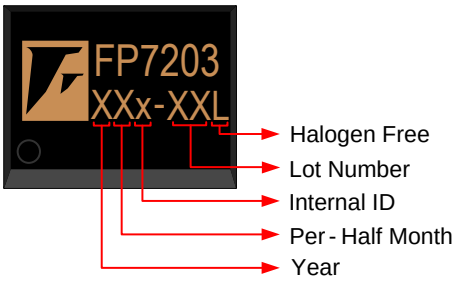
SOP-8L(EP)



Name	No.	I / O	Description
PGND	1	P	IC Power Ground
FB	2	I	Error Amplifier Inverting Input
OVP	3	I	Over Voltage Protection
Vcc	4	P	IC Power Supply
EN	5	I	Enable Control (Active High)
GND	6	P	IC Ground
LX	7	O	Power Switch Output
LX	8	O	Power Switch Output
EP	9	P	IC Power Ground

Marking Information

SOP-8L



Halogen Free: Halogen free product indicator

Lot Number: Wafer lot number's last two digits

For Example → Lot : 123456 → XXx-56L

Internal ID: Internal Identification Code

Per-Half Month: Production period indicator in half month time unit

For Example : A → First Half Month of January
B → Second Half Month of January
C → First Half Month of February
D → Second Half Month of February

Year: Production year's last digit

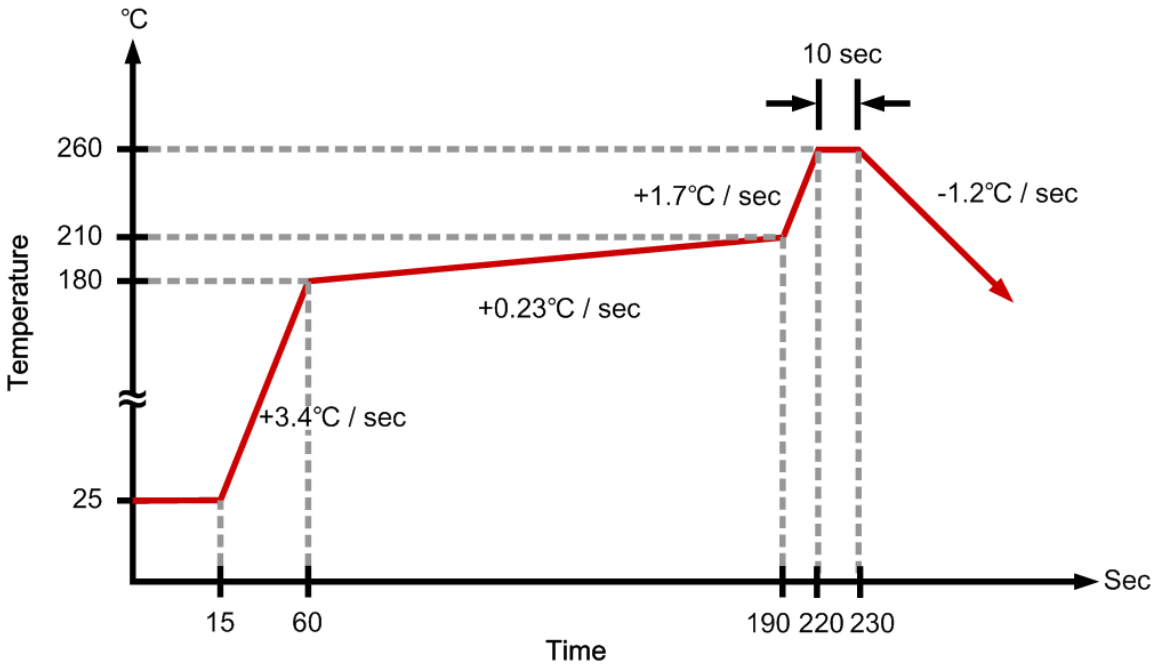
Ordering Information

Part Number	Operating Temperature	Package	MOQ	Description
FP7203XR-G1	-40°C ~ 85°C	SOP-8L(EP)	2500EA	Tape & Reel

Absolute Maximum Ratings

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Supply Voltage	V_{CC}		0		6	V
LX Voltage	V_{LX}		0		18	V
EN,FB Voltage			0		6	V
Thermal Resistance	θ_{JA}	SOP-8L(EP)			+60	°C / W
	θ_{JC}				+10	°C / W
Junction Temperature	T_J				+150	°C
Operating Temperature	T_{OP}		-40		+85	°C
Storage Temperature	T_{ST}		-65		+150	°C
Lead Temperature		(soldering, 10 sec)			+260	°C

IR Re-flow Soldering Curve



Recommended Operating Conditions

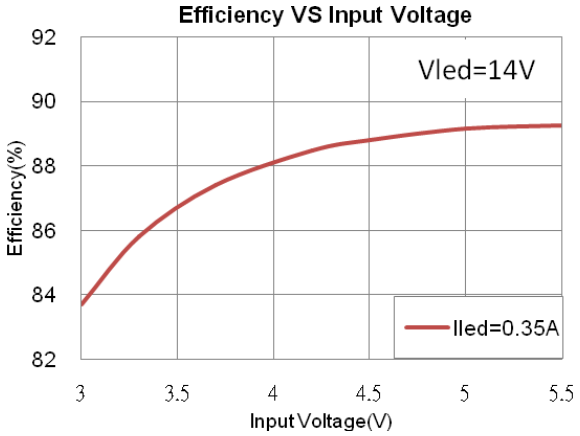
Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Supply Voltage	V_{IN}		2.6		5.5	V
Operating Temperature Range	T_A	Ambient Temperature	-40		+85	°C

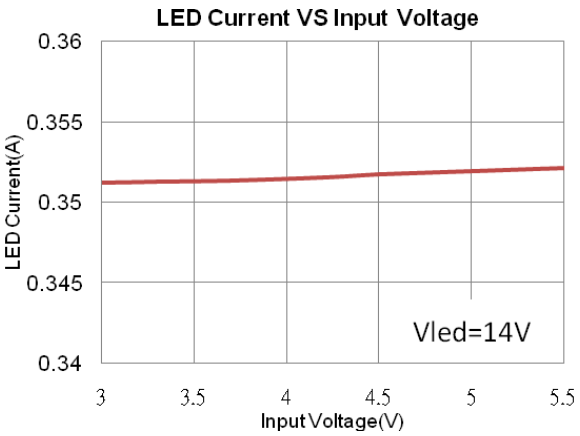
DC Electrical Characteristics (V_{CC}=3.3V, T_A=25°C, unless otherwise specified)

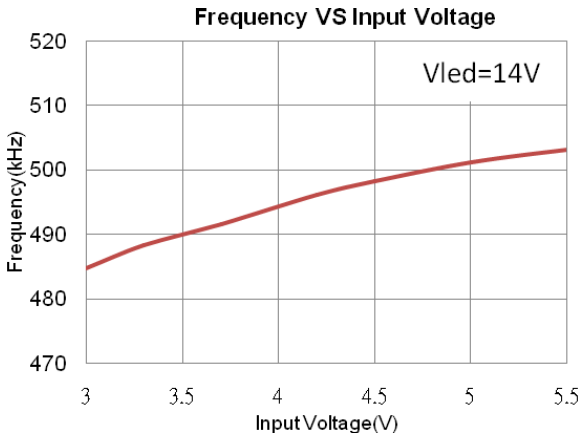
Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
System Supply Input						
Input Supply Range	V_{CC}		2.6		5.5	V
Under Voltage Lockout	V_{UVLO}			2.2		V
UVLO Hysteresis				0.1		V
Quiescent Current	I_{CC}	V_{FB}=0.3V, No switching		0.19		mA
Average Supply Current	I_{CC}	V_{FB}=0V, Switching		2.84		mA
Shutdown Supply Current	I_{CC}	V_{EN}=GND		0.1		μA
Oscillator						
Operation Frequency	F_{OSC}	V_{FB}=0V		500		KH_Z
Frequency Change with Voltage	$\Delta f / \Delta V$	V_{CC}=2.6V to 5.5V		5		%
Maximum Duty Cycle	T_{DUTY}			90		%
Reference Voltage						
Reference Voltage	V_{REF}			0.25		V
Line Regulation		V_{CC}=2.6V ~ 5.5V		0.2		% / V
Enable Control						
Enable Voltage	V_{EN}		0.96			V
Shutdown Voltage	V_{EN}				0.6	V
MOSFET						
On Resistance of Driver	$R_{DS\ (ON)}$	I_{LX}=2A		0.1		Ω
Protection						
OCP Current	I_{OCP}			4.5		A
OVP Threshold Voltage	V_{OVP}			0.5		V
OTP Temperature	T_{OTP}			+150		°C

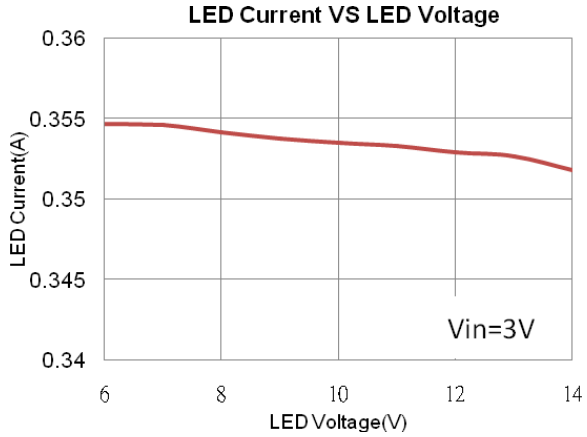
Typical Operating Characteristics

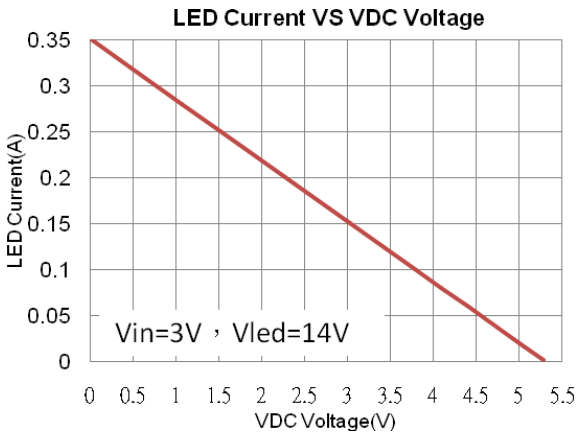
(V_{IN}=3V, T_A=25℃, unless otherwise specified)

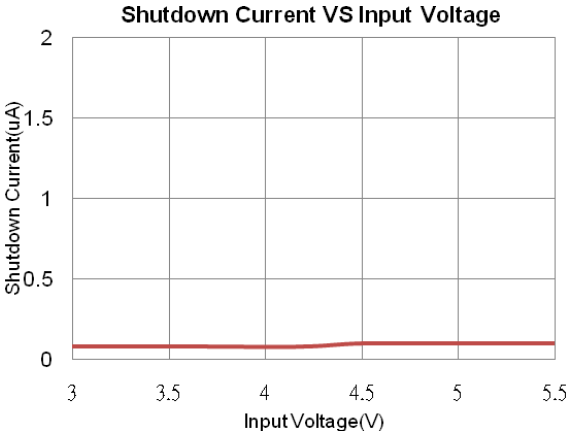












Function Description

Operation

The FP7203 is a current mode boost converter for LED driver. The constant switching frequency is 500KHz and operates with pulse width modulation (PWM). Build-in 18V / 4.5A MOSFET provides a high output voltage for 2~4 white LEDs. The control loop architecture is peak current mode control; therefore slope compensation circuit is added to the current signal to allow stable operation for duty cycles larger than 50%. The feedback reference voltage is only 0.25V, reducing the power dissipation in the current sensing resistor.

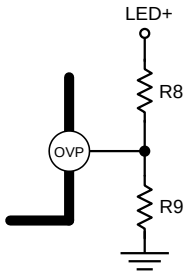
Over Temperature Protection (OTP)

FP7203 will turn off the power MOSFET automatically when the internal junction temperature is over 150°C. The power MOSFET wake up when the junction temperature drops 20°C under the OTP threshold temperature.

Over Voltage Protection (OVP)

The gate driver signal is turned off when OVP pin voltage exceeds 0.5V. The voltage (V_{OVP}) can be calculated using formula below, and circuit is shown as below.

$$V_{OVP} = 0.5V\left(1+\frac{R8}{R9}\right)$$

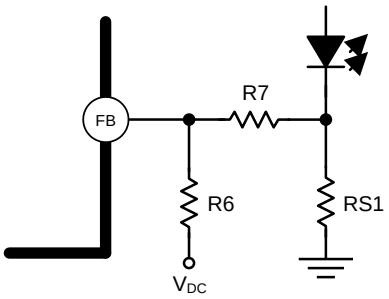


Dimming Control

Dimming control can adjust LED brightness. There are two ways to control LED current for the FP7203, as shown in the following.

a. Using a DC Voltage

The first way uses a variable DC voltage to control the feedback voltage. When the DC voltage increases, and the circuit loop through R6 and R7 to regulate the feedback voltage. It will reduce the LED current.

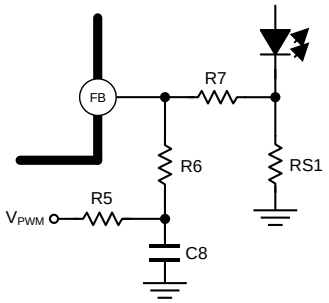


The LED current can be calculated by the following equation:

$$I_{LED} = \frac{V_{FB} - \frac{R_7 \times (V_{DC} - V_{FB})}{R_6}}{RS1}$$

b. Using a Filtered PWM Signal

The filtered PWM signal can be considered as an adjustable DC voltage. It can be used to replace the variable DC voltage source in dimming control. The application circuit is shown in the following.



The LED current can be calculated by the following equation:

$$I_{LED} = \frac{V_{FB} - \frac{R_7 \times (V_{PWM} \times Duty - V_{FB})}{R_5 + R_6}}{RS1}$$

Application Information

Inductor Selection

Inductance value is decided based on different condition. 3.3μH to 10μH inductor value is recommended for 2 to 4 WLEDs applications. There are three important inductor specifications, DC resistance, saturation current and core loss. Low DC resistance (DCR) has better power efficiency. Also, it avoids inductor saturation causing circuit system unstably and lower core loss at 500KHz.

Capacitor Selection

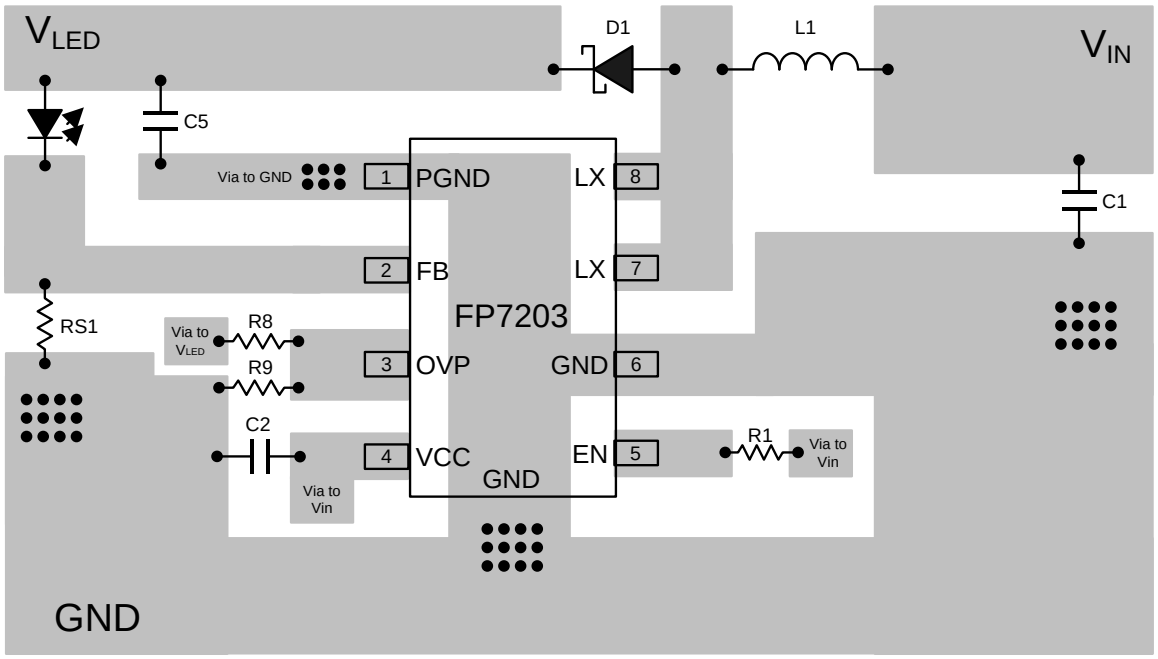
The output capacitor is required to maintain the series LED voltage during . Low ESR capacitors are preferred to reduce the output voltage ripple. Ceramic capacitor of X5R and X7R are recommended, which have low equivalent series resistance (ESR) and wider temperature range.

Diode Selection

Schottky diodes have fast recovery times and low forward voltages are recommended. Ensure that the diode average and peak current rating exceeds the average output current and peak inductor current. In addition, the diode's reverse breakdown voltage must exceed the open LED protection voltage.

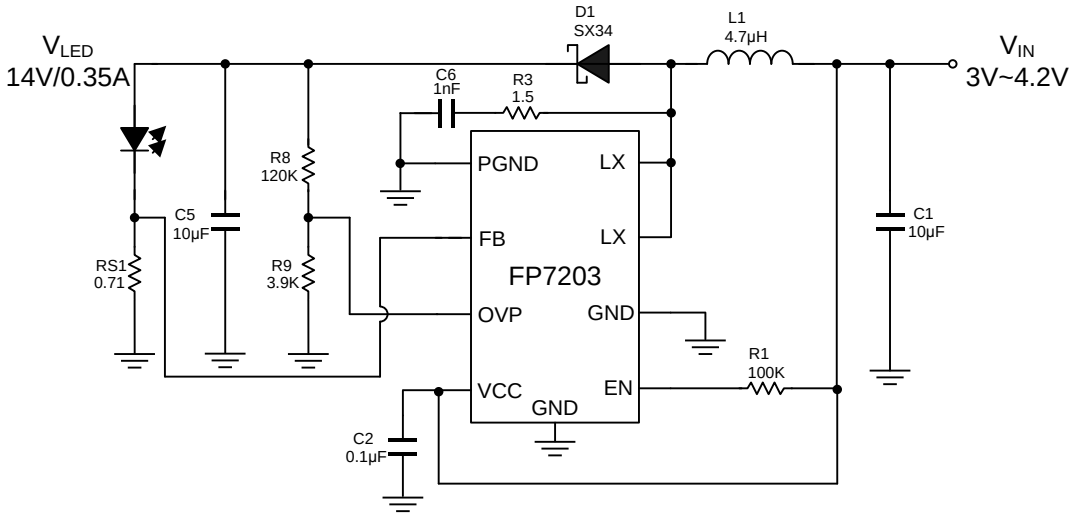
Layout Considerations

1. The power traces, consisting of the GND trace, the LX trace and the V_{CC} trace should be kept short, direct and wide.
2. LX、Inductance L1 and Diode D1 switching node, wide and short trace to reduce EMI.
3. Place C_{IN} near V_{CC} pin as closely as possible to maintain input voltage steady and filter out the pulsing input current.
4. Feedback resistance RS1 must be connected to FB pin directly and as closely as possible.
5. FB is a sensitive node. Please keep it away from switching node, LX.
6. The GND of the IC, C_{IN}, C_{OUT} should be connected close together directly to a ground plane.

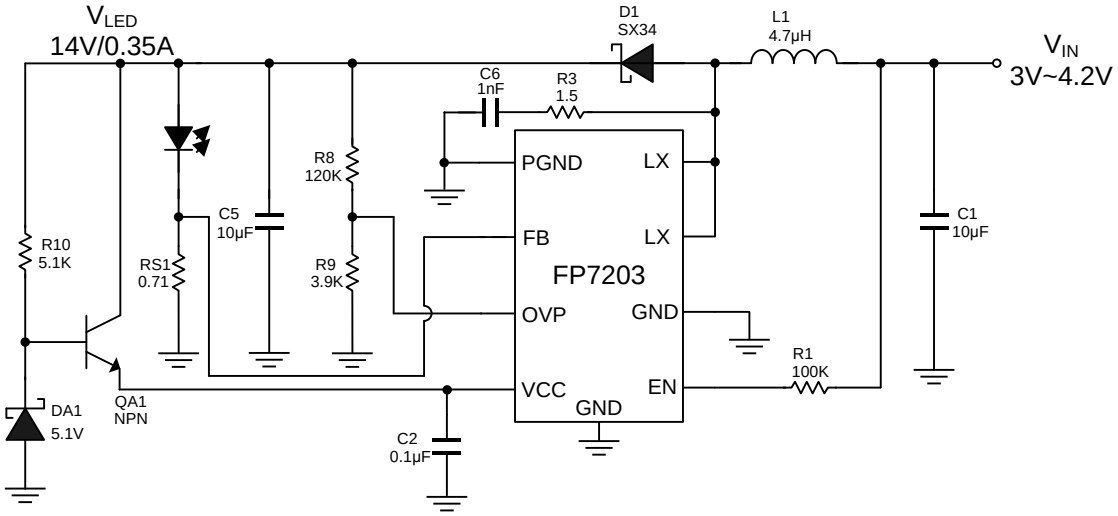


Suggested Layout

Typical Application



Typical Circuit



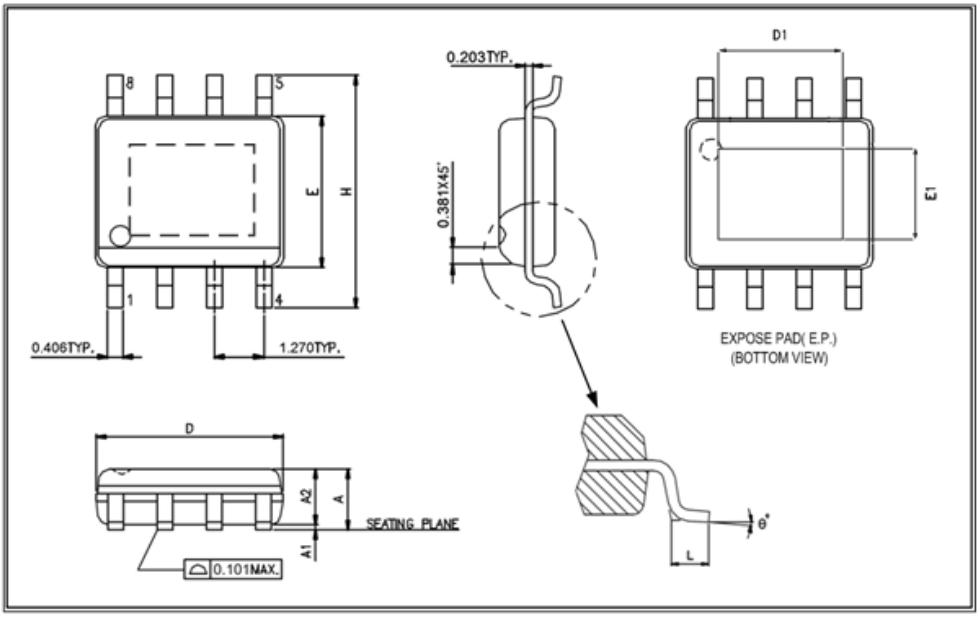
High Efficiency Circuit

Note:

1. C1 and C5 choose ceramic capacitor of X5R or X7R.
2. The EN voltage can't higher than VCC voltage.

Package Outline

SOP-8L (EP)



UNIT: mm

Symbols	Min. (mm)	Max. (mm)
A	1.30	1.70
A1	0	0.15
A2	1.25	1.55
D	4.70	5.10
E	3.80	4.00
H	5.80	6.20
L	0.40	1.27

Exposed PAD Dimensions:

Symbols	Min. (mm)	Max. (mm)
D1	2.60	3.45
E1	1.90	2.56

Note:

1. Package dimensions are in compliance with JEDEC outline: MS-012 AA.
2. Dimension ”D” does not include molding flash, protrusions or gate burrs.
3. Dimension “E” does not include inter-lead flash or protrusions.